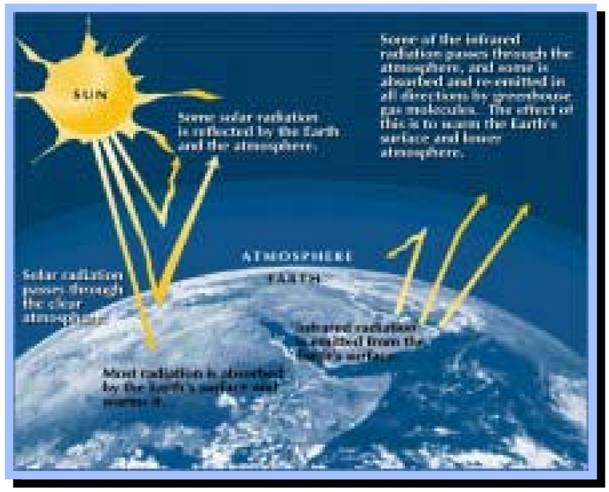
AB 1493 (Pavley) Briefing Package

Global Warming and Greenhouse Gas Emissions from Motor Vehicles

Prepared by the California Environmental Protection Agency

The Greenhouse Effect



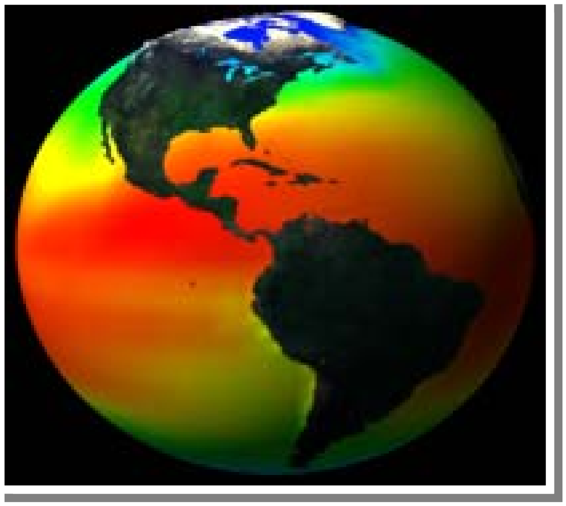
Source: U.S. EPA State and Local Climate Change Outreach Kit, March 2000

The Earth's atmosphere acts in many respects like an immense greenhouse, trapping heat from the sun. Sunlight enters the atmosphere, and about 30 percent of the sun's energy is immediately reflected back into space. But the Earth also radiates heat back to the atmosphere, where some of it is absorbed by "greenhouse gases" in the atmosphere, such as carbon dioxide. This further warms the planet.

This is the "greenhouse effect," and it is a natural phenomenon. The presence of greenhouse gases like carbon dioxide and methane keeps the Earth's average surface temperature at approximately 60 degrees Fahrenheit. Without the greenhouse effect, the average temperature would be about 5 degrees Fahrenheit.

Put simply, the greenhouse effect makes it possible for us to live on Earth.

Evidence For Global Warming



- The issue is real
- Discernible "first signs" are being seen now
- Some human-induced climate change is likely inevitable.

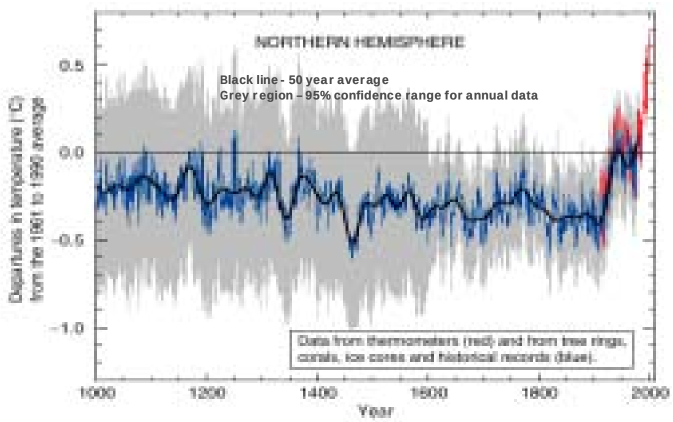
Source: U.S. EPA State and Local Climate Change Outreach Kit, March 2000

In recent years, the U.N.'s Environment Programme and World Meteorological Organization brought together a number of the world's leading independent scientists to address the issue of climate change. This panel of scientists is called the Intergovernmental Panel on Climate Change, or the IPCC for short.

The IPCC looked at the global temperature record and other evidence and determined that the average temperature of the planet has significantly risen over the last century, as shown in the next slide. The average temperature has its ups and downs during individual decades, but the overall trend is up.

Of course, climate change brings with it some uncertainties. We can't say for sure what will happen. But there is a great deal of scientific consensus on the subject. Penn State professor and editor of the journal, *Climate Research*, Brent Yarnal says, "I know of no scientific area of study that has more consensus than the field of global warming."

The World Is Warming



Sources: IPCC Report: Summary for Policy Makers, Climate Change 2001: The Scientific Basis
NCDC Website

- **The rate and duration of warming of the 20th century has been much greater than in any of the previous nine centuries.**
- **Similarly it is likely that the 1990s have been the warmest decade and 1998 the warmest year of the millennium.**
- **At the halfway point, 2002 is the second warmest year on record.**

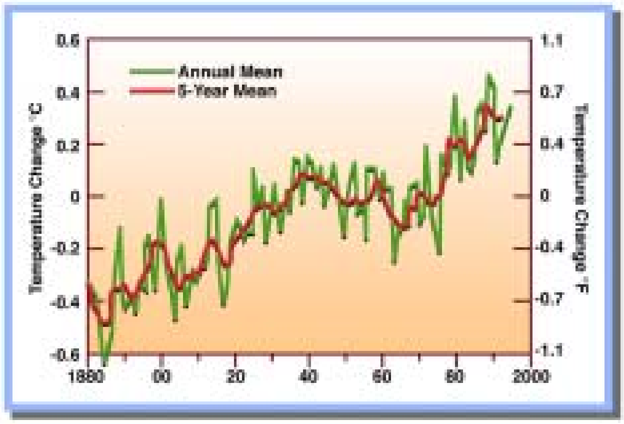
Concerns about global warming must be taken very seriously. Most scientists working on this problem worldwide now acknowledge that global climate change is a reality. The only remaining questions are how much and how soon. An overall warming trend has been recorded since the late 19th century, with the most rapid warming occurring over the past two decades. The 10 warmest years of the last century all occurred within the last 15 years – 1998 was the warmest year on record. At halfway through this year, 2002 is shaping up to be second warmest year on record globally, according to the National Climate Data Center.

Global temperature rose a full degree over the last century and is forecast by the International Panel on Climate Change to increase between 2 and 10 degrees Fahrenheit over the next 100 years.

The recent National Academy of Science (NAS) climate change analysis requested by President George W. Bush (NRC, 2001) and the Third Assessment Report of the International Panel on Climate Change (IPCC, 2001) conclude that the global climate is changing at a rate unmatched in the past one thousand years.

The IPCC Assessment cites new and stronger evidence that most of the global warming observed over the last fifty years is attributable to human activities and that anthropogenic climate change will persist for many centuries. However, while the NAS Report generally agrees with the IPCC Assessment, it does not rule out that some significant part of these changes is also a reflection of natural variability.

Observed Global Surface Air Temperatures

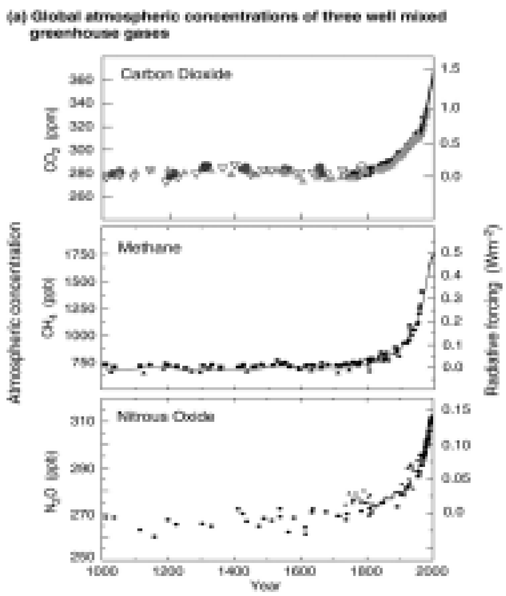


- $+1^{o}$ C (almost 2^{o} F) since 1880
- Melting of glaciers
- Sea level rose 4 to 8 inches
- +2 to 6^{o} F predicted by 2100

Source: Adapted from NASA Goddard Institute for Space Studies, New York

Confirmation of this warming trend is further substantiated by the 4 to 8 inch rise in sea level that has occurred since 1900 and the decrease in the average snow cover and glacial ice worldwide. Unseasonable weather phenomena are becoming commonplace and intensities appear to be increasing. A continued increase in greenhouse gases, and the associated temperature rise, is likely to accelerate the rate of climate change.

Industrial Era Has Changed The Atmosphere



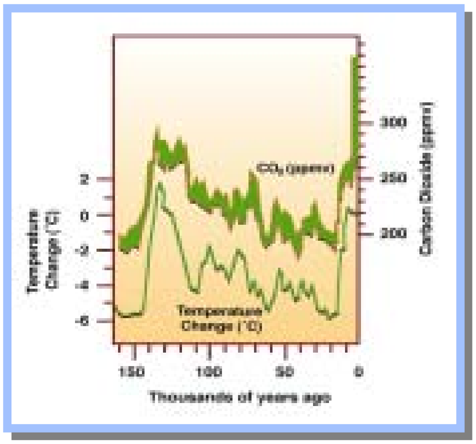
- **Carbon dioxide, methane, nitrous oxide, and other pollutants cause global warming**
- **IPCC concludes increase in these gases is a result of human activities**

*Source:*IPCC Report: Summary for Policy Makers, Climate Change 2001: The Scientific Basis

Since the industrial revolution, human activity has dramatically changed the composition of the atmosphere. Combustion of fossil fuels produces large amount of carbon dioxide. Carbon dioxide absorbs infrared radiation, heating the surrounding air and trapping it at the Earth's surface, much as the air in a car with the windows rolled up is trapped and heated.

The concentration of carbon dioxide in the atmosphere has risen approximately 25 percent since pre-industrial times and is continuing to increase by approximately one-half percent per year. Human activities have also increased atmospheric concentrations of other greenhouse gases such as methane and nitrous oxide. Methane emissions have doubled in the past 100 years. Over the same period, nitrous oxide levels have risen about 15 percent.

Temperature Tracks Carbon Dioxide



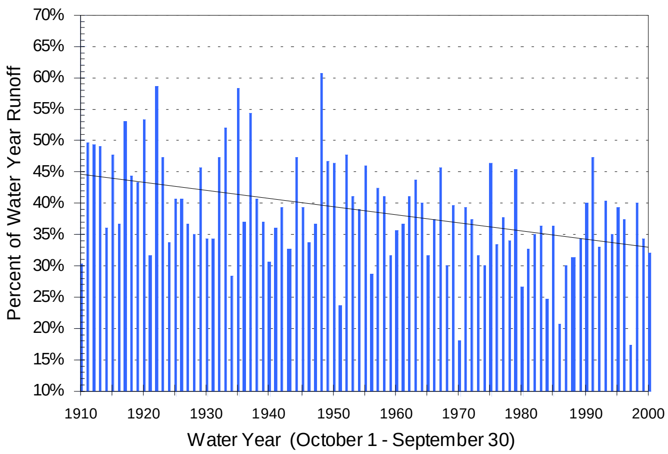
Source: Adapted from Office of Science and Technology Policy, Climate Change State of Knowledge, October 1997

- **Ice core records show the current rate of increase and levels are unprecedented**

Analysis of ice core records indicates that current atmospheric levels of carbon dioxide are the highest of the past 160,000 years and show a close correlation between the concentration of greenhouse gases in the atmosphere and global temperatures.

California's ecosystems and economy could be seriously impacted by changes in climate. For example, because of the lack of rain for six months of the year, storage of snowmelt is critical to providing Californians with year round water. Warmer winters could make it more difficult to meet California’s water needs.

Our Principal Reservoir - The Sierra Snow Pack - Is Shrinking



Warmer Winters Have:

- **Reduced snow pack**
- **Led to earlier snow melt**
- **Decreased spring runoff by 10%**
- **Major effects on water supply, Cal Fed, and Delta system**

Sacramento River Runoff (1910-2000) - April to July as a Percent of Total Runoff

Source: California Environmental Protection Agency, Environmental Protection Indicators for California, 2001

The volume water from spring snowmelt runoff, relative to the total volume of runoff for the "water year" (October through September), provides a measure of temperature-related precipitation and runoff patterns. Large accumulations of snow occur in the Sierra Nevada and southern Cascade Mountains from October to March. Each winter, at the high elevations, snow accumulates into a deep pack, preserving much of California's water supply in cold storage. Spring warming causes snowmelt runoff, mostly during April to July. If the winter temperatures are warm, more of the precipitation falls as rain instead of snow, and directly runs from watersheds before the spring runoff. Other factors being equal, there is less buildup of snow pack; as a result, water from the spring runoff is diminished. Lower water volumes of the spring snowmelt runoff may indicate warmer winter temperatures.

A heavier rainfall burden in the winter results in higher flood risks and reduced recreational opportunities in the mountains. Less spring runoff can reduce the amount of water available for hydroelectric power production. Lower runoff volumes can also impact recreation areas, and impair cold water habitat for salmonid fishes.

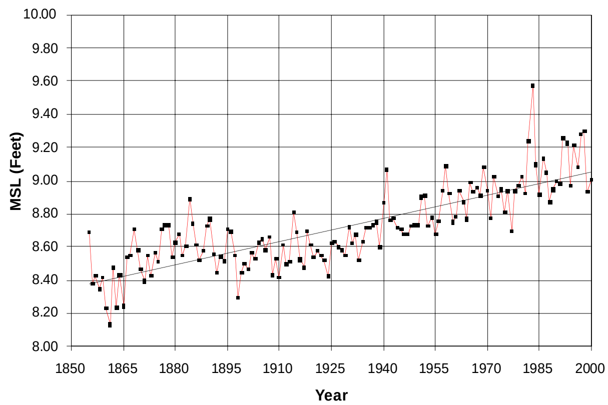
The warming of California's climate would increase evaporation rates, thereby increasing precipitation. The yearly ratio of rain to snow depends on temperature, as does snow level elevations (an estimated 500-foot elevation change for every 1^{o}C (1.8^{o}F) rise in storm temperature). Higher snow level elevations mean reduced snow pack and lower spring water yields.

Snow melt and runoff volume data can be used to document changes in runoff patterns. These changes are likely due to increased air temperatures and climate changes. Other factors, such as the Northern Pacific Ocean oscillations and, possibly air pollution, probably contribute to the patterns observed.

Over the 20th century, annual April to July spring unimpaired runoff, represented as a percentage of total year water runoff from the accumulated winter precipitation in the Sierra Mountains, has been decreasing. ("Unimpaired" runoff refers to the amounts of water produced in a stream unaltered by upstream diversions, storage, or by export or import of water to or from other basins.) This decreased runoff was especially evident after mid century, where the water runoff has declined by about ten percent. Most of the change took place after 1950 and the recent two decades seem to indicate a flattening of the percentage decrease.

River Runoff	***Percent Decline over the 20st Century***
Sacramento	12
Truckee	15
San Joaquin	8
Kings	7
East Carson and West Walker	9

Sea Level Is Rising Along California's Coast



San Francisco Yearly Mean Sea Level (1855-2000)

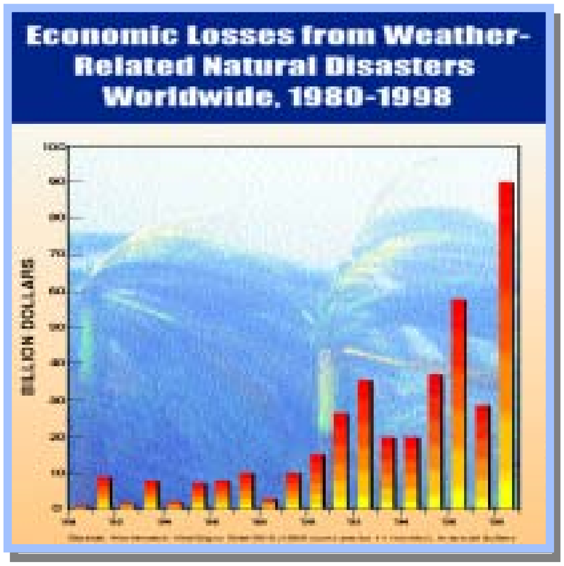
- **CA has already seen a 7" rise in 150 years**
- **Concerns over levee stability and salt water intrusion**
- **IPCC projects 4-35" sea level rise by 2100**
- **Present Delta system may not be viable at upper end of range**

Source: California Environmental Protection Agency, Environmental Protection Indicators for California, 2001

Another outcome of global warming is a predicted rise in sea level. This has already been observed in California. The San Francisco data were obtained from the Golden Gate tide gauge. The San Francisco record begins in 1855 and represents the longest continuous time series of sea level in North America (Flick, 1998). The record at San Francisco shows a rate of about 0.47 ft./century from 1855 to 1997 but from 1925 to 1997, that rate changed to 0.75 ft./century, which is nearly identical to the 0.74 ft./century trend at La Jolla over the same period. This agrees with tide gauge data that show that global average sea-level rose between 4 to 8 inches during the 20th century.

Sea level rise and storm surges could lead to flooding of low-lying property, loss of coastal wetlands, erosion of cliffs and beaches, saltwater contamination of drinking water, and impacts on roads, causeways, and bridges. California's hundreds of miles of scenic coastline contain ecologically fragile estuaries, expansive urban centers, and fisheries that could be impacted by future sea level elevations.

Extreme Weather Events Are Increasing



Causing Billions of Dollars in Damages

Source: World watch Vital Signs Brief 98-5 (1998 costs are for 11 months). In actual dollars.

10

Increases in extreme weather events, like heat waves and hurricanes and floods, are not proof of global warming. And yet they are the kind of event that scientists believe could become more frequent and more intense in a warmer world.

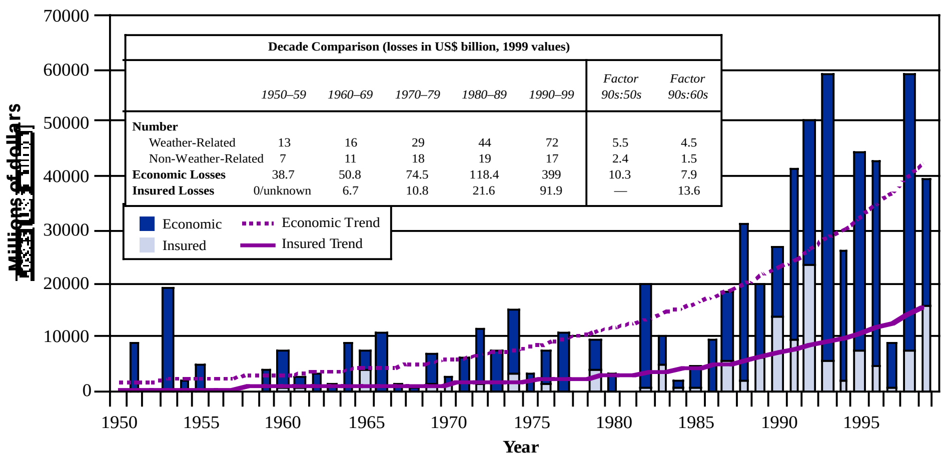
In 1998 alone, the damage from extreme weather was significant:

Hurricane Mitch caused at least 11,000 deaths in Central America.

The 1998 winter ice storm in Canada and New England cost $2.5 billion in damages.

According to a study conducted by federal scientists, El Niño years, which involve a shift in ocean currents and wind patterns in the Pacific Ocean and consequent weather changes throughout the world, may become even stronger as a result of global warming. The federal scientists found that over the past century, El Niño years have become more frequent and warmer.

Global Disaster-Related Losses



Decade Comparison (losses in US$ billion, 1999 values)

	1950–59	*1960–69*	*1970–79*	*1980–89*	*1990–99*	*Factor 90s:50s*	*Factor 90s:60s*
Number							
Weather-Related	13	16	29	44	72	5.5	4.5
Non-Weather-Related	7	11	18	19	17	2.4	1.5
Economic Losses	38.7	50.8	74.5	118.4	399	10.3	7.9
Insured Losses	0/unknown	6.7	10.8	21.6	91.9	—	13.6

Source: IPCC Working Group II Third Assessment Report, 2001

The costs of extreme weather events have exhibited a rapid upward trend in recent decades. The economic trend line shows that yearly economic losses from large events increased ten-fold from $4 billion in the 1950s to $40 billion per year in the 1990s. The insured portion of these losses rose from a negligible level to $9 billion annually during the same period. Notably, the costs are a factor of two larger when losses from small, non-catastrophic weather-related events are included.

Human Activities Can Intensify The Greenhouse Effect

Transportation

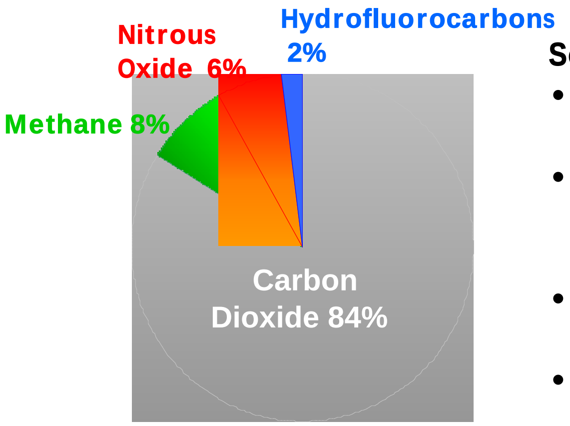
Industry

Utilities

Source: U.S. EPA State and Local Climate Change Outreach Kit, March 2000

Unfortunately human activities can intensify the greenhouse effect—and that's where we run into problems. Many human activities produce greenhouses gases. For example, when we burn fossil fuels such as oil, coal, and natural gas for energy to power our cars, homes, and factories, we put carbon dioxide into the air.

1999 California Greenhouse Gas Emissions



Sources

- **Carbon Dioxide (CO_2)**
  - **4Fossil fuel combustion**
- **Methane**
  - **4Fossil fuels**
  - **4Landfills, agriculture**
- **Nitrous Oxide**
  - **4Agriculture, cars**
- **Hydrofluorocarbons**
  - **4Refrigerants, solvents**

Source: Draft Greenhouse Gas Inventory Update, California Energy Commission, 2001
In CO_2 equivalents

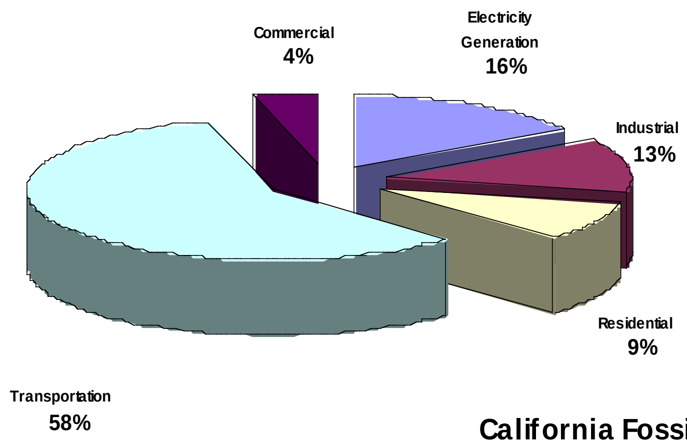
While carbon dioxide is the greenhouse gas emitted in the largest quality, other greenhouse gases such as methane, nitrous oxide, and fluorocarbons also contribute to the problem.

Gases vary greatly in their global warming potential, so in order to accurately assess their impact in relationship to one another, CO_2 is used as the common denominator and the values of other gases are expressed in CO_2 equivalents.

In California, CO_2 accounts for approximately 84 percent of all the greenhouse gases. Methane makes up approximately 8 percent of the total and nitrous oxide and hydrofluorocarbons contribute an additional 6 and 2 percent, respectively. The principal sources of CO_2 in the atmosphere are fossil fuel combustion and the burning of forests and plants. Agriculture is a major source of both methane and nitrous oxide, with additional methane coming primarily from landfills. Cars also emit methane and nitrous oxide.

Synthetic gases such as hydrofluorocarbons (HFCs) have low atmospheric concentrations, but absorb infrared radiation strongly and are much more effective as greenhouse gases than carbon dioxide. On a molecule-for molecule basis, they can be 1,000 times more efficient in absorbing infrared energy. Therefore, any significant increase in HFCs emitted into air could conceivably contribute to global warming.

Transportation Is California's Largest Source of CO_2

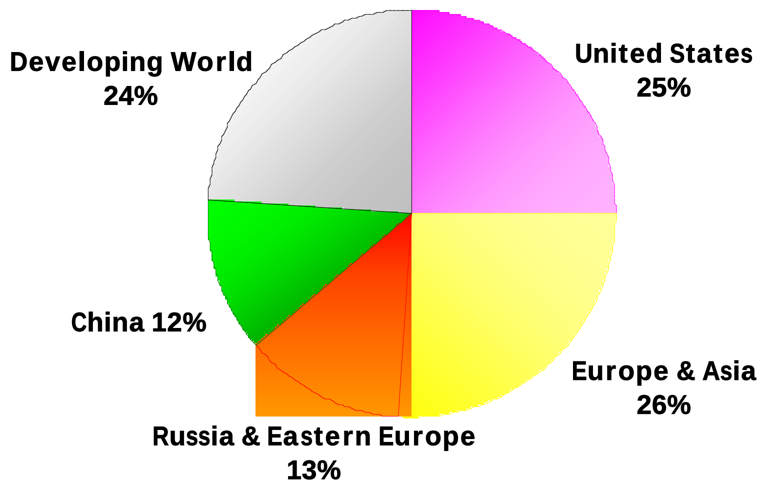


California Fossil Fuel CO_2 Emission Sources, 1999

Source: Draft Greenhouse Gas Inventory Update, California Energy Commission, 2001

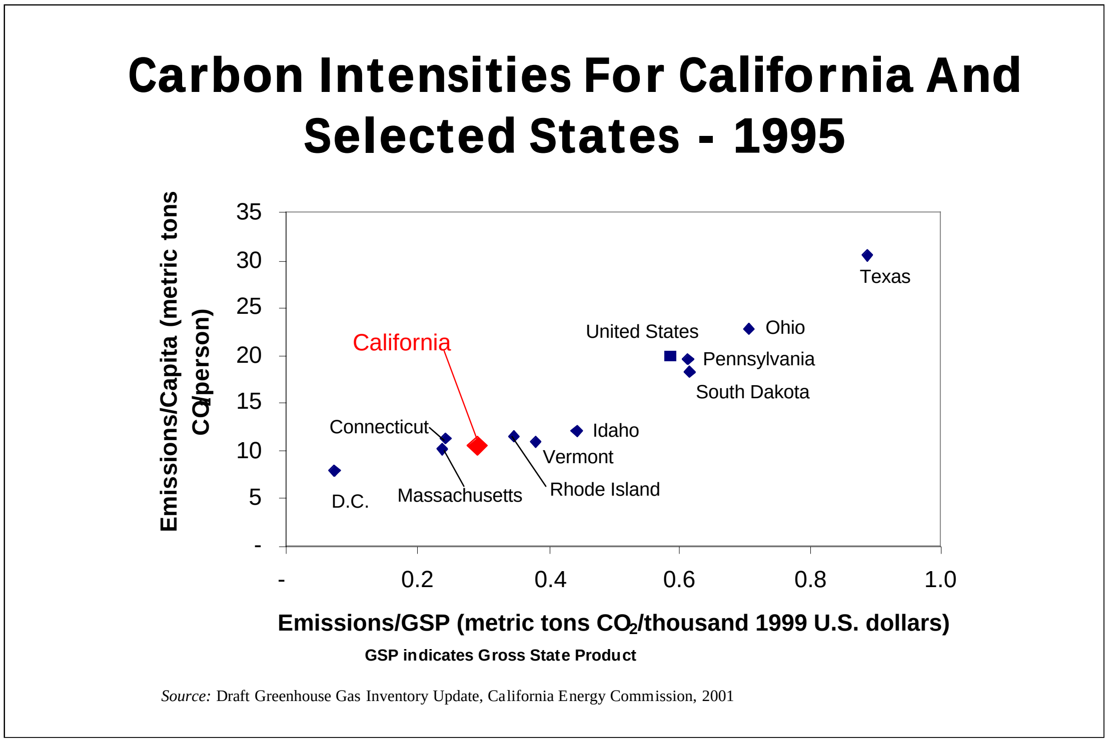
In California, more than half of fossil fuel emissions of carbon dioxide (CO_2) are related in some way to transportation. (Fossil fuels account for 98 percent of CO_2 emissions, with a 2 percent contribution from several industrial processes that produce CO_2 as a by-product.)

U.S. Is The Largest Single Contributor To Greenhouse Gas Emissions



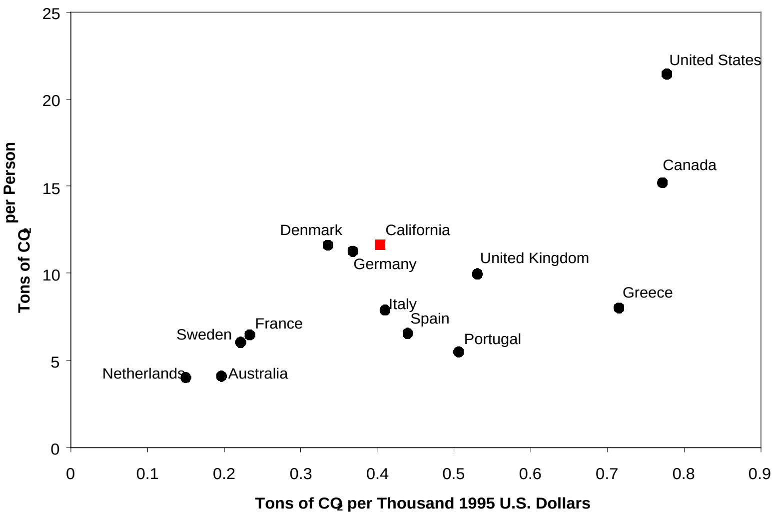
Source: U.S. EPA Global Warming Website
In 1998 CO_2 Equivalents

The increase in carbon dioxide and other greenhouse gases is primarily the result of human activity. In 1996, the United States, with 4.6 percent of the world population, was responsible for approximately one quarter of the total greenhouse gas emissions worldwide.



California's emissions are somewhat lower than the national average due to the use of less polluting energy sources, such as natural gas, to run our power plants. We also have a favorable climate that decreases the heating demand and there are fewer high energy industries in California than in other states.

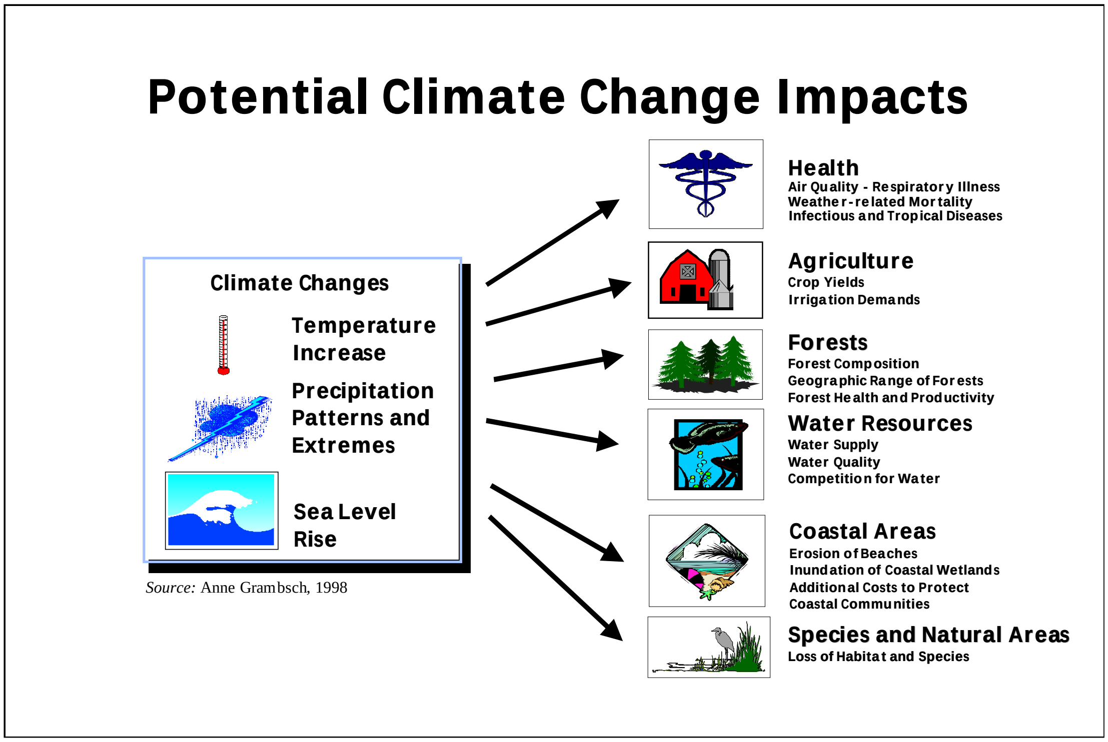
Carbon Intensities For California And Selected Countries - 1995



Source: Draft Greenhouse Gas Inventory Update, California Energy Commission, 2001

If we look at the distribution of emissions on a per capita basis, we find that the United States contributes more greenhouse gas emissions per person than any other industrialized nation. While we may produce less than the U.S. average, California's citizens still generate more CO_2 emissions on average per capita than individuals in other parts of the world.

California is also below the United States in terms of emissions produced per unit of gross national product.

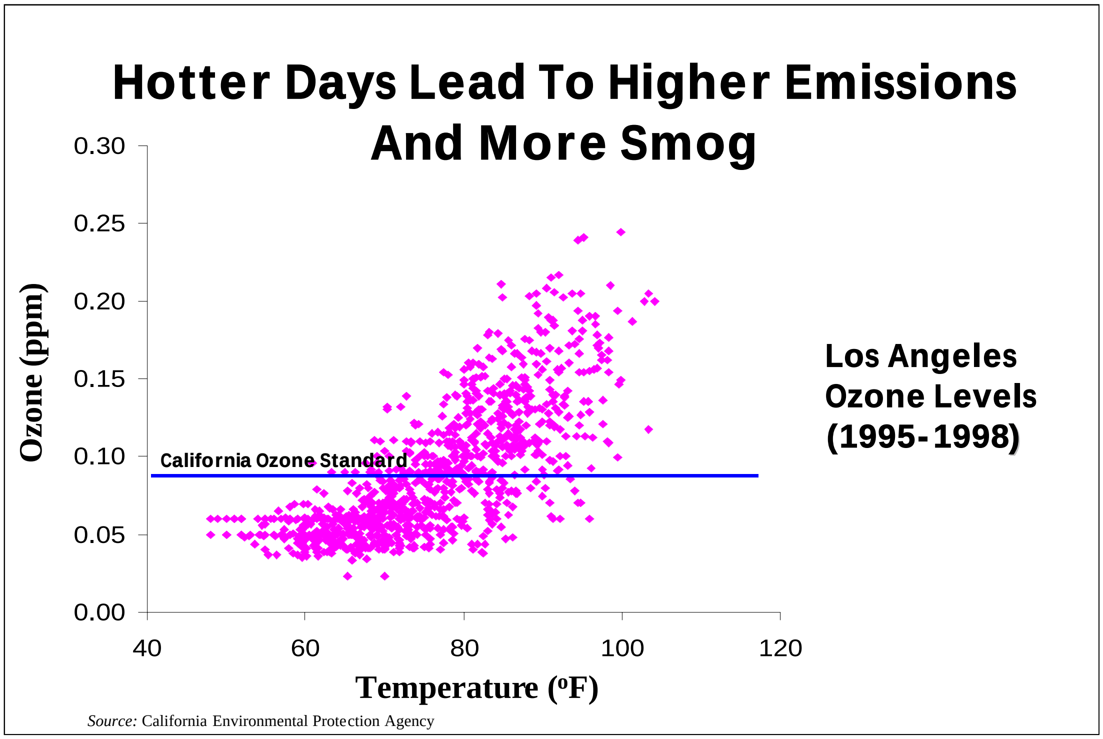


Projected climate changes will impact California's public health through changes in air quality, the number of weather related deaths, and possible increase in infectious disease. If extreme precipitation and severe weather events become more frequent, and sanitation and water-treatment facilities have inadequate capacity or are not maintained, increases in infectious diseases may result.

Agriculture may be particularly affected by regional climate changes. Farmers could encounter altered growing conditions, such as new pest problems or erratic temperatures and rainfall patterns. These conditions have a negative effect on plant's ability to withstand a climatic assault. Increased temperature can contribute to ground level ozone, which is generally damaging to plants and inhibits their uptake of CO_2.

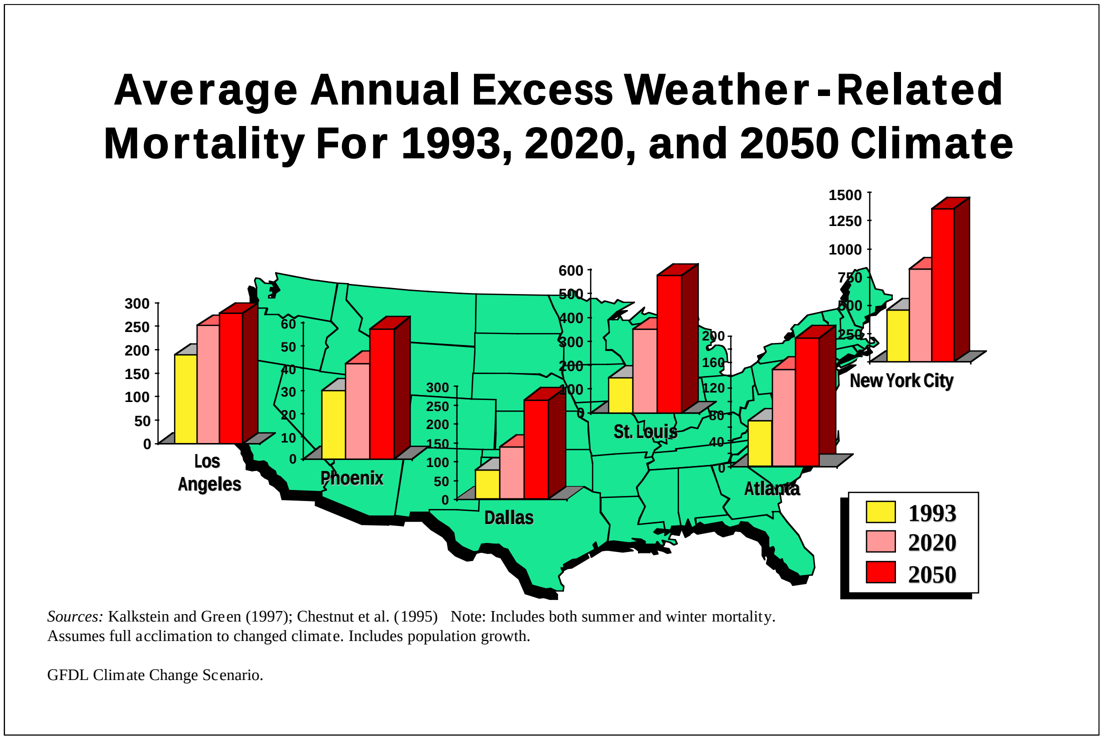
In the lower stream flows, dry season would cause increased salinity intrusion, thus risking salt contamination of freshwater supply for domestic use.

All of these changes would impact species dependent on estuarine and riparian habitats, possibly enhance conditions for invasive plant and pest species, and increased stress on endangered/threatened species.



Changes in weather patterns can also influence the frequency of meteorological conditions conducive to the development of high pollutant concentrations. For example, during the 1997 El Niño year, there was only one Stage 1 smog alert (ozone greater than 0.20 parts per million) in Los Angeles. The following year, climatic conditions spawned by La Niña resulted in 12 alerts, even though emission levels were lower. Such extreme weather conditions are expected to increase over the coming years.

There is also a direct relationship between ambient air temperatures and the secondary production of ozone – weather conditions associated with warmer temperatures increase smog. High temperatures, strong sunlight, and a stable air mass tend to create the ideal conditions for ozone formation. Higher temperatures cause an increase in emissions: more fuel evaporates, engines work harder, and the demands on power plants increase. Air pollution is also made worse by increases in natural hydrocarbon emissions during hot weather. As the temperature rises and air quality diminishes, there is additional exposure to both particles and ozone and the incidence of pollution, and heat related health problems increase.



In July 1995, the temperature hovered at about 104 degrees Fahrenheit in Chicago. Heat-related mortality mounted over a period of five days to a final count of 733 deaths.

We cannot say that these specific deaths were caused by global warming. We do expect that global warming will contribute to unstable weather, including more extremes in temperature and heat waves. As a consequence, there is a very good chance that the number of heat-related deaths will also rise.

This slide shows the projected annual excess mortality increases in the number of deaths above the baseline from more intense heat waves for Los Angeles, Phoenix, Dallas, St. Louis, Atlanta, and New York City.

Worldwide Likelihood Of Insect-borne Diseases Will Increase

Disease	Insect	Population at risk (millions)	Present distribution	Likelihood of altered distribution with warming
Malaria	mosquito	2,100	(sub)tropics	••
Schistosomiasis	water snail	600	(sub)tropics	••
Filariasis	mosquito	900	(sub)tropics	•
Onchocerciasis (river blindness)	black fly	90	Africa/Latin America	•
African trypanosomiasis (sleeping sickness)	tsetse fly	50	tropical Africa	•
Dengue	mosquito	unavailable	tropics	••
Yellow fever	mosquito	unavailable	tropical South America & Africa	•

Likely •
Very likely ••

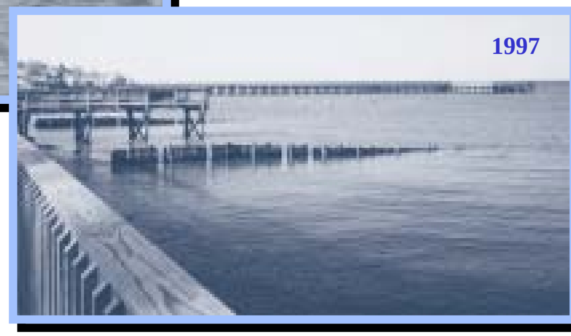
Source: Modified World Health Organization (WHO), as cited in Stone (1995).

Americans have not worried about these tropic-region diseases because their carriers could not survive in our more temperate climate. But that could change soon, according to a group of scientists who have examined animal and plant diseases worldwide. They contend that global warming may be making the world a better place for parasites.

Infectious diseases can cause rapid population declines or species extinctions as reported in the just-published article in the June 21, 2002 issue of *Science* by Harvell et al. Many pathogens are sensitive to temperature, rainfall, and humidity. Climate warming can increase pathogen development and survival rates, disease transmission, and host susceptibility. Although most host-parasite systems are predicted to experience more frequent or severe disease impacts with warming, a subset of pathogens might decline with warming, releasing hosts from disease. Recently, changes in El Niño-Southern oscillation events have had a detectable influence on marine and terrestrial pathogens, including coral diseases, oyster pathogens, crop pathogens, Rift Valley fever, and human cholera.

Rising Seas, Vanishing Shores

Sea level rose 4-8” worldwide during the 20th century



North Beach, Maryland

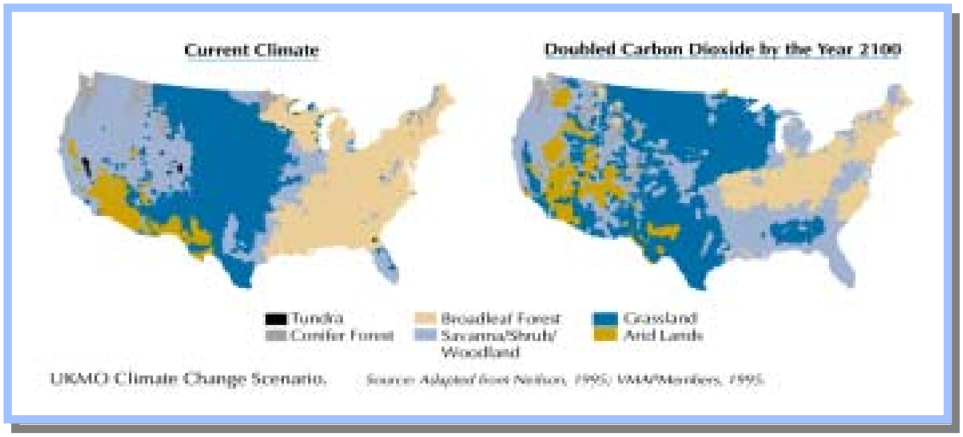
Source: EPA State and Local Climate Change Outreach Kit, March 2000

As we saw in an earlier slide, another indicator of a changing climate is the rise of sea level worldwide. Water expands as it heats up, and the warming ocean has risen nearly 1 foot in many areas. Scientists believe that it will rise up to 3 feet over the next century.

Sea level rise could erode beaches, increase storm surges, lead to a loss of wetlands, and compromise water supplies. California's beaches could change dramatically.

The IPCC scientists concluded from all of this—the temperature rise over the past century, the melting glaciers, sea level rise, and other evidence—that “most of the global warming observed over the last fifty years is attributable to human activities and that man-made climate change will persist for many centuries.”

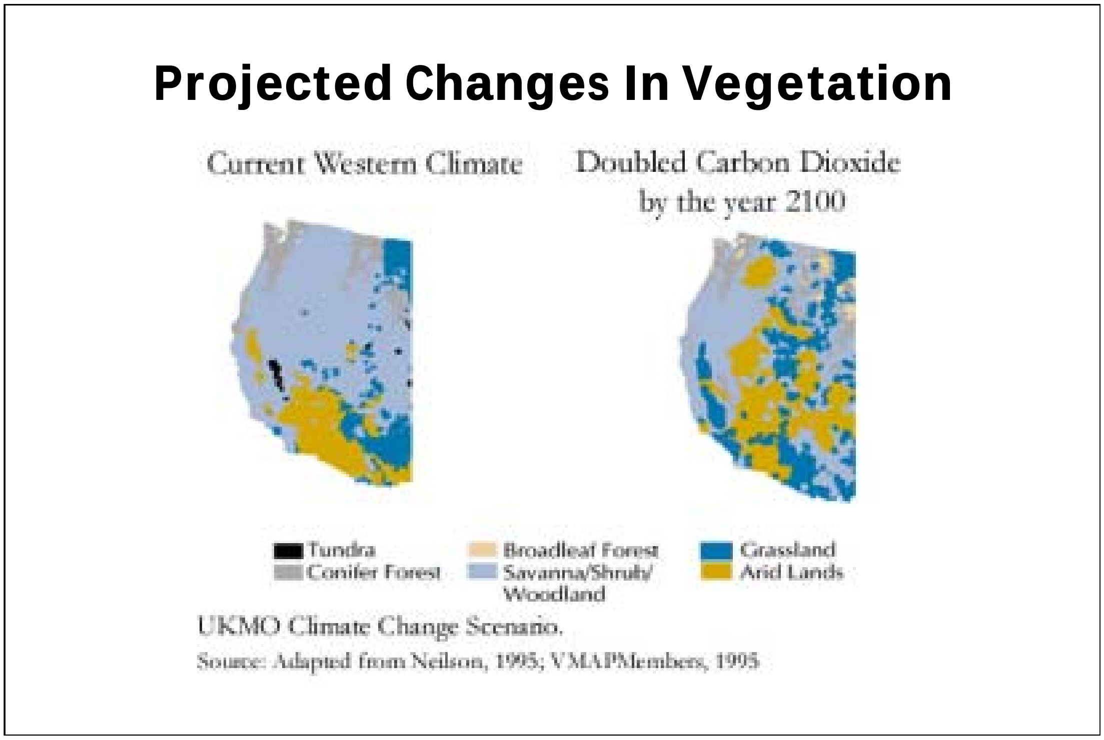
Projected Changes In Vegetation



Climate change is likely to alter habitats such as forests, causing loss of certain tree species in some areas. For example, as this map shows, the broadleaf forest that covers much of the eastern United States would be greatly reduced under climate change resulting from a doubling of CO_2 by the year 2100.

Consequently, the number of animal species listed as threatened or endangered is likely to increase.

Climate change is likely to increase the frequency and severity of droughts in some areas and increase precipitation in other areas. This means that the habitats required by ducks, birds, frogs, and many other species dependent on ponds and streams may decline.



Doubling of atmospheric concentrations of carbon dioxide could increase the extent of arid lands in the western United States. In California, grasslands will replace areas which are currently arid, savanna, or woodland. These changes would have potentially devastating impacts on agriculture.

The Economic Impact Of Global Warming On U.S. Agriculture

Economic loss could amount to $13.6 billion annually in 1990 dollars

Source: Schlenker, Wolfram, et al., "The Impact of Global Warming on U.S. Agriculture," University of California, Berkeley, June 2002

Agricultural lands cover 11 percent of the state but 87 percent of that crop area requires irrigation water. If the climate shifts toward a severe drought extreme, not only will more irrigation be needed but also the snow pack at higher elevations will be lacking. This can be disastrous for producers of crops such as fruit trees and vines which will require years to reestablish production. Growers of perennial crops cannot shift quickly to new cultivates as conditions change. They are most vulnerable to shifts in climate and to extreme events such as drought or pest outbreaks. If California agriculture were to lose one or more crops to climate change, it would most likely be crops that use large amounts of water. The economics of producing and selling crops will depend, in turn, on the impacts of global climate change on worldwide agricultural markets.

Wolfram's estimate that climate change could cause an economic loss to U.S. agriculture amounting to about $13.6 billion per annum in the dryland, non urban farming counties, plus some additional quantum of loss in the irrigated counties, compares quite well with several of the earlier estimates in the literature.

AB 1493 Economic Aspects

- Consider economic impacts, including impacts on jobs, businesses, and California business competitiveness with other states
- Achieve the maximum cost-effective and technologically feasible method to reduce carbon dioxide emissions
- Provide automobile manufacturers maximum flexibility
- Offer numerous alternatives
- Allow opportunity for legislative oversight

AB 1493 would require the California Air Resources Board (ARB) to set emission standards for greenhouse gases. This is not a mandate for specific technology.

AB 1493 requires ARB to consider economic impacts, including impacts on jobs, businesses (including agriculture), and California business competitiveness with other states.

AB 1493 requires ARB regulations to provide "maximum flexibility" and be economical to consumers. There is no "one size fits all" mandate.

AB 1493 requires ARB to consider cost-effectiveness, technological feasibility, economic impacts and mandate maximum flexibility to manufacturers. Legislature provided one year to review regulations prior to becoming operative.

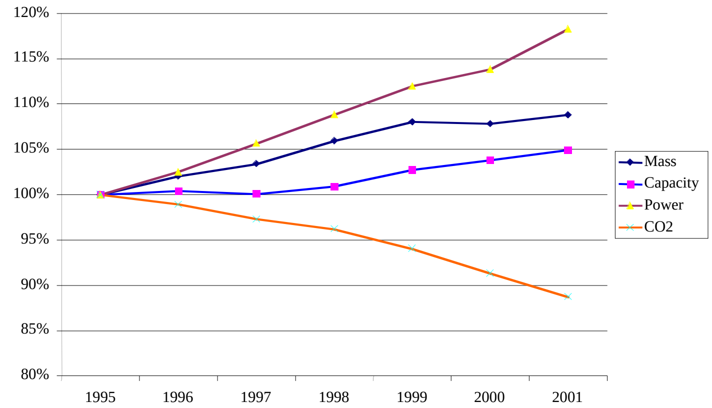
Technologies That Reduce Greenhouse Gas Emissions

	Technology	GHG Reduction, %	Current Models Using This Technology
Off-the-Shelf Engine Technologies			
1	Variable valve timing and lift	3-8	BMW, Honda
2	Cylinder deactivation	3-6	Cadillac
3	Smaller engine with supercharger	5-7	Mercedes
4	Throttleless engine	3-6	BMW
5	Hybrid electric drive	15-30	Toyota Prius
Off-the-Shelf Transmission Technologies			
1	5-speed automatic	2-3	Ford Explorer (SUV)
2	Continuously variable transmission	4-8	Saturn VUE (SUV)
Emerging Engine Technologies			
1	Camless valve actuation	15	
2	Variable compression ratio	2-6	

Source: Data extracted from a 2001 report of the National Academy of Sciences
Greenhouse gas (GHG) emission reductions are based on CO_2

The California Air Resources Board (ARB) would adopt a set of maximum greenhouse gas emission levels, and automakers would design a mix of vehicles and might take other actions to meet the emission standards. This is the same approach that ARB has taken in its successful program to reduce conventional smog forming emissions from vehicles. For example, tail pipe emission standards set by ARB resulted in the now universal choice by automakers to use catalytic converters to meet the emission standard. ARB's evaporative emission standards resulted in the automakers employing canisters and purge systems to control evaporative hydrocarbon emissions. The chart identifies some technologies that automakers may choose to meet a greenhouse gas standard under AB 1493.

New Automobile Fleet Characteristics and CO_2 Emissions In Europe



Average CO_2 emissions for new vehicles decreased significantly in Europe despite increases in vehicle mass, power, and engine capacity

Source: European Automobile Manufacturers Association and the Commission Services, "Monitoring of ACEA's Commitment on CO2 Emission Reduction from Passenger Cars," June 2002

For cars sold within the European Union between 1995 to 2001, the European Automobile Manufacturers Association has cut its average new car CO_2 emissions by 11.4 percent with an average annual reduction of 1.9 percent per year. During this same period the average mass, power, and engine capacity of new cars has increased 8.8 percent, 19.0 percent, and 4.9 percent, respectively.

The Japan Automobile Manufacturers Association has demonstrated similar success in Europe. Between 1995 and 2001 the average CO_2 emissions of new cars manufactured by JAMA have decreased by 8.7 percent while average mass, power, and engine capacity have increased 10.2 percent, 8.6 percent, and 2.9 percent, respectively.